

Epidemiology of SARS-CoV-2 among healthcare workers in North-Eastern Italy from March 1, 2020 to May 10, 2020

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ABSTRACT

Background: *During major epidemic outbreaks, the preparedness of public health systems is challenged and healthcare workers (HCWs) are at the frontline. Italy was among the first- and worst-hit countries by COVID-19. Aim:* To analyze the prevalence and incidence of infection among HCWs in Friuli Venezia Giulia region (north-eastern Italy) from March 1 to the end of the Italian lock-down, May 10, 2020. *Methods.* HCWs exposed to COVID-19 patients were actively surveyed and all HCWs were routinely tested with nasopharyngeal and oropharyngeal swab for RNA virus detection (n. 54,670). **Results:** Infected HCWs (n. 595) represented the 32.3% of all COVID-19 cases in the region under 65 years of age, and incidence of infection was 11.4 cases/1000 workers. HCWs accounted for a significant proportion of coronavirus infection and experienced high infection incidence after unprotected contact. *Conclusions.* HCWs' knowledge of SARS-CoV-2 epidemiology and proper infection control practices are critical to the control of the disease.

INTRODUCTION

On January 30, 2020, WHO announced the outbreak of the severe acute respiratory syndrome (SARS-CoV-2) as a public health emergency of international concern (1). The next day, the Italian Government declared a state of emergency. The first Italian autochthonous case of SARS-CoV-2 occurred on February 20 in the Lombardy region (north Italy). An early large outbreak involving Lombardy and neighbouring northern areas followed (2). Despite implementing restrictions, the virus rapidly spread, resulting in Italy being among

the first and worst hit countries by SARS-CoV-2 (1). Consequently, a nationwide lockdown was imposed from March 9 to May 4 (3).

The first case in Friuli Venezia Giulia was recorded on March 1, 2020 and health care workers were in the frontline working with patients and colleagues, fighting against an unknown virus, in a condition of uncertainty, with difficulties in protective equipment availability mainly in the first week of the pandemic. But the role of HCWs was crucial for the prevention of the spread of infection (4). Moreover, HCWs died because of a SARS-CoV-2 infection they acquired during their duties. The

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analysis of the diffusion of COVID-19 in HCWs population screened routinely for SARS-CoV-2 in nasopharyngeal swabs is crucial to understand the diffusion of the virus and to implement the measures of prevention and control.

This paper reports data on contagion spread among health care workers (HCWs) after exposure to COVID-19 patients in the Friuli Venezia Giulia Region (FVG, northeast Italy, 1.2 million residents) from March 1 to the end of the Italian lockdown, May 10, 2020.

METHODS

From March 1, 2020 to May 10, 2020, all HCWs with unprotected contact (according to ECDC guidelines) (5) with a COVID-19 case were surveyed. Since April 15 all workforce was weekly or monthly screening for virus in nasopharyngeal swabs, according to exposure risk. During the first 2 weeks of March, HCWs were unaware of the COVID-19 status when approaching patients consequently adherence to the WHO guidelines for personal protective equipment was limited (5), especially during the HCW meetings, where protective masking was not compulsory. HCWs exposed to a COVID-19 patient or colleague had to report the event by e-mail to the Occupational Medical Division that applied the surveillance protocol using a standardized questionnaire to evaluate the exposure risk, the number of individual contacts, and the activities performed during exposure. HCWs were then daily actively surveyed to record the onset of symptoms. Nasopharyngeal and oropharyngeal specimens were collected after 3, 7, 13 days after the contact using the swab technique (overall 54,670 tests were performed), and RNA was determined by rRT-PCR, targeting the E, N and RdRp genes according to the CDC and Charité laboratory protocols (6).

Data was analysed using STATA™ v. 16.0 (Stata Corp., LP, College Station, TX, USA). Continuous data was expressed as median (25-75 percentiles) and compared using ANOVA. Differences between proportions were evaluate using chi-square statistics. Calculation of incidence of infection was done using ISTAT (Istituto Nazionale di Statistica) pub-

lished data (7). Data on the overall number of cases in FVG were made available to the public by the regional Health Authorities. The number of people who were effectively reported infected at time t (R_t) was estimated using the R code by Vaidyanathan (8), as published by Systrom (9).

COVID-19 as an outcome was analysed by univariate logistic regression analysis, with, as independent variables, sex, age (as a continuous variable), work tasks, workplaces (hospitals, long-term facilities, outside hospitals), exposure (likely occupational, likely non-occupational and undefined). Factors significantly associated to COVID-19 infections in univariate logistic regression analysis were investigated with multivariate regression analysis. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated from the coefficients and the standard errors of logistic regression. Workers with missing data for relevant variables were excluded from analysis.

A p-value of <0.05 was established as the limit of statistical significance.

RESULTS

From the onset of the epidemic and to the end of March 2020, the epidemic was enforced by a >1 R_t . From April 4, the estimated R_t was declining and almost constantly below 1, with the high CI limit being almost constantly below 1.5 (Figure 1).

Between March 1 and May 10, 595 (19%) out of the 3,130 COVID-19 cases in FVG were HCWs. Considering all cases younger than 65 years, 32.3% were HCWs in FVG Region. The contribution of HCWs to SARS-CoV-2 cases younger than 65 years old was higher in Trieste (60%) where a Covid-19 dedicated hospital is set and lower in Gorizia (1.3%) where a small Covid-19 free hospital is located (Table 1).

Figure 2 displays the contribution of HCWs with COVID-19 in FVG region and in Trieste by age groups and sex. In some age groups, HCWs were the majority of all COVID-19 cases. In Trieste, female HCWs represented 80% and 82% of all COVID-19 cases in the age groups 20-29 and 30-39, respectively, remaining over 60% also in older workers. Male contribution is lower but higher than 65% in HCWs 20-39 years old.

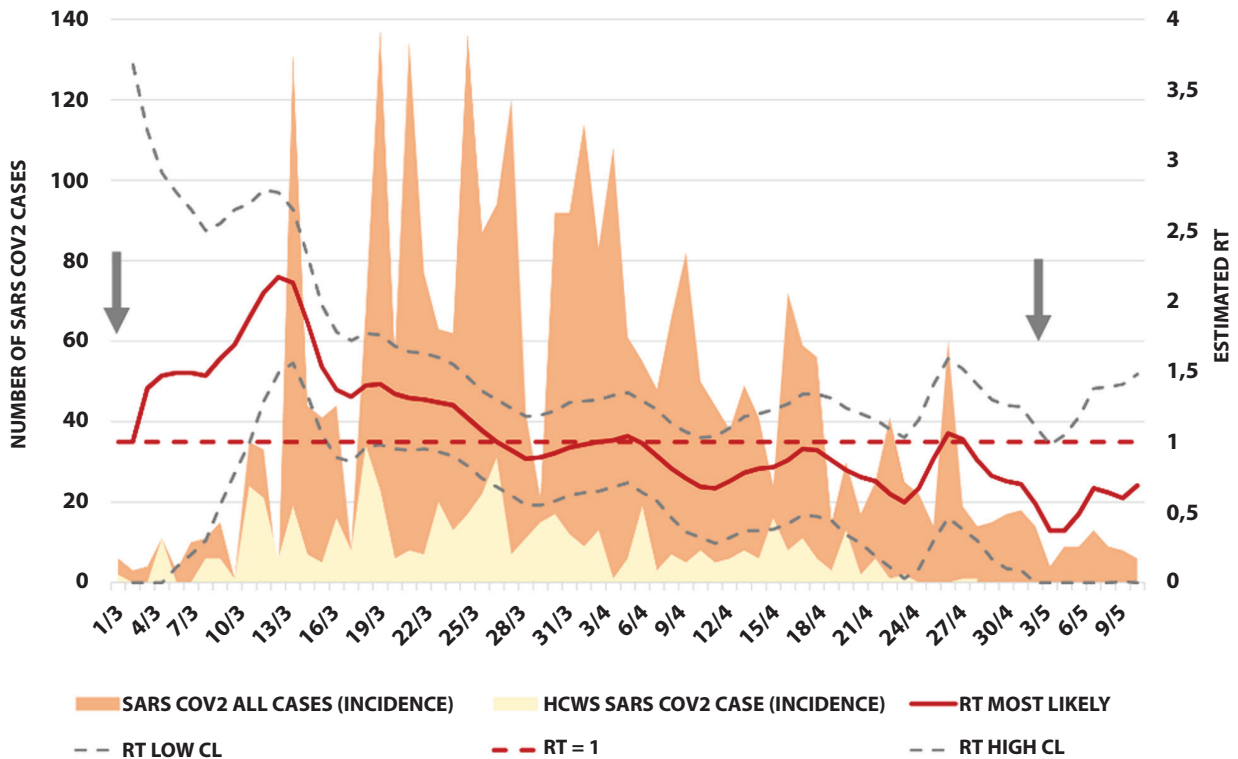


Figure 1. The estimated number of people who became infected per infectious person at time t (R_t) is described (Y2 axis) together with incidence of all people and health care worker cases (Y1 axis) occurring in Friuli Venezia Giulia (north-east Italy) during the 1st March to 10th May Italian SARS-CoV-2. Arrows indicate start and end of SARS-CoV-2 lockdown in Italy.

Table 1. Characteristics of the population studied and demographic aspects in the 4 provinces considered

COVID-19 cases	Trieste	Udine	Pordenone	Gorizia	Total
Inhabitants n.	234,493	528,791	312,533	139,403	1,215,220
Inhabitants/Km ² n.	1,103	106	137	298	153
Total COVID-19 cases n.	1,316	968	651	195	3,130
Cases/1000 inhabitants n.	6	2	2	1	2.5
Cases/inhabitants/Km ² n.	6.6	0.2	0.27	0.29	0.38
Total COVID-19 cases <65 years old n. (% on total cases)	637 (51.1)	543 (59.3)	395 (62.6)	147 (75.4)	1,841 (58.8)
HCWs infected n. (% on COVID-19 cases <65 years old)	384 (60.3)*	142 (26.1)	67 (17.0)	2 (1.4)	595 (32.3)
- HCWs in hospitals n. (%)	166 (43.2)	46 (32.4)	51 (76.1)	2 (100)	265 (44.5)
- HCWs In long-term care facilities n. (%)	200 (52.1)	85 (59.9)	13 (19.4)	0	298 (50.1)
- HCWs outside hospitals n. (%)	18 (4.9)	11 (7.7)	3 (4.5)	0	32 (5.4)
HCWs occupied n.	11,396	22,633	12,569	5,423	52,021
Cases/1000 HCWs n.	33.7*	6.3	5.3	0.37	11.4
HCWs women n. (%)	278 (72.4)	118 (83.1)	51 (76.1)	1 (50)	448 (75.3)
HCWs median age (IQ)	46 (34-54)	44.5 (34-55)	49 (37-54)	48.5 (46-51)	46 (35-54)

COVID-19 cases	Trieste	Udine	Pordenone	Gorizia	Total
Job task					
- Medical doctor n. (%)	35 (9.1)	11 (7.5)	8 (11.9)	1 (50)	85 (9.2)
- Nurses n. (%)	86 (22.4)	41 (28.9)	24 (35.8)	0	151 (25.4)
- Assistant nurses n. (%)	152 (39.6)	66 (56.5)*	26 (38.8)	0	244 (41.0)
- Residents n. (%)	16 (4.2)	1 (0.7)	0	0	17 (2.9)
- Others n. (%)	95 (24.7)	23 (16.2)	9 (13.4)	1 (50)	128 (21.5)
Exposure					
- Likely occupational n. (%)	245 (63.8)	98 (69.0)*	43 (64.2)	0	386 (64.9)
- Likely non occupational n. (%)	19 (4.9)	14 (9.9)	8 (11.9)	0	40 (6.7)
- Undefined n. (%)	121 (31.5)	30 (21.1)	16 (23.9)	2 (100)	169 (28.4)
Symptoms					
Yes n. (%)	285 (74.2)*	49 (34.5)	36 (53.7)	1 (50)	371 (62.3)

*p<0.01 Symptoms in Trieste were recorded daily until the end of swab test positivity

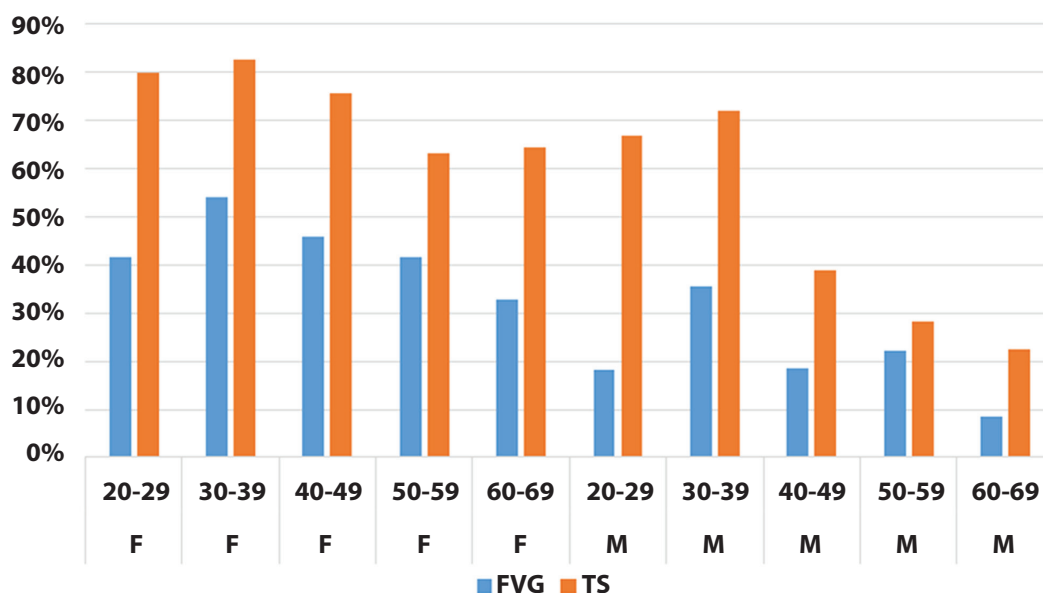


Figure 2. Percentages of health care workers infected in Friuli Venezia Region (FVG) and in Trieste subgroup on the total of COVID-19 cases for age classes and sex

General characteristics of COVID-19 cases and workers by province are reported in Table 1. Infection was mainly encountered at the workplace for the 64.9% of the infected HCWs, and involved mostly workers employed in nursing homes (50.1%) and hospitals (44.5%). HCWs were found to account for almost 50% of total cases that were detected by targeted surveillance in HCWs during the early 12 days of epidemic in FVG (Figure 1). Almost 70% of the cases among HCWs occurred during the first

month, showing that the progressively implemented measures helped containing SARS-CoV-2 among HCWs. Indeed, only one infected HCW was identified by the routine monthly screening of HCWs implemented in the region starting on April 15. Among HCWs, 62.3% of the cases were symptomatic at the first swab test, mainly with mild upper respiratory tract symptoms. Whether with or without symptoms, an HCW detected positive was isolated/quarantined and did not contribute to infection spreading.

The crude incidence of COVID-19 positive among HCWs was significantly higher in Trieste (33.6 cases/1000 workers during the study period), compared to Udine, Pordenone and Gorizia (6.3, 5.3 and 0.37 cases/1000 workers, respectively).

Factors associated to COVID-19 infections are reported in Table n. 2 using univariate and multivariate logistic regression analysis. HCWs in Udine and Pordenone presented a significant lower risk to be SARS-CoV-2 positive (OR 0.17; 95%CI 0.11-0.26 and OR 0.38; 95% CI 0.22-0.65, respectively). To work outside hospitals was associated to a lower risk (OR 0.48; 95%CI 0.23-0.99), but only in univariate logistic regression analysis.

No difference was shown considering sex, age, job tasks, occupational and non-occupational exposure.

DISCUSSION

Our study demonstrated the important role of HCWs in Friuli Venezia Giulia Region during the first outbreak of SARS-CoV-2 infection that

accounted for 1/3 of total cases in people younger than 65 years old and 60% of total cases in women younger than 65 years old in Trieste. These data confirm the first line of HCWs in COVID-19 infection and are much higher than those reported in China (5.1% of total cases through 18 February 2020) (10), in Italy (12%) (2) and in the USA (19% of which 55% reported occupational contact with COVID-19 patients) and 9.6% in Los Angeles County) (11), but all these studies did not stratify for age classes and gender.

Our incidence data confirmed the higher risk for HCWs compared to general population of the region, but our figures are lower than those reported by Suarez-Garcia et al. (12) from February 24 to April 30, 2020 in Spain (11.1% of COVID-19 among 1911 HCWs), by Magnavita et al. (13) in Rome (13.8%) and by Colaneri et al. (14) in Milan (11.33%) in a similar period. Our study obtained results similar to those reported in Verona (Italy) where HCWs were routinely screened.. In this study Benoni et al. (15) found an incidence of COVID-19

Table 2. Factors associated to COVID-19 symptoms in HCWs in Friuli Venezia Giulia region evaluated using the univariate and multivariate regression analysis and reported as OR (odd ratios) and 95% CI (Confidence intervals). In bold are reported significant values

	Univariate OR (95%CI)	Multivariate OR (95%CI)
Age	1.0 (0.99-1.01)	1.0 (0.99-1.0)
Women vs men	0.75 (0.50-1.1)	0.78 (0.51-1.2)
Location of work		
- Trieste	1	1
- Udine	0.18 (0.12-0.28)	0.17 (0.11-0.26)
- Pordenone	0.40 (0.24-0.69)	0.38 (0.22-0.65)
- Gorizia	0.35 (0.021-5.6)	0.30 (0.02-6.0)
- HCWs in hospitals	1	1
- HCWs in long-term facilities	0.99 (0.70-1.4)	(0.69-1.5)
- HCWs outside hospitals	0.48 (0.23-0.99)	0.3 (0.01-1.9)
Job task		
- Physician	1	
- Nurses	0.78 (0.41-1.5)	
- Assistant nurses	0.68 (0.37-1.3)	
- Residents	0.87 (0.28-2.7)	
- Others	0.90 (0.5-1.8)	
Exposure		
- Likely occupational	1	
- Likely non occupational	0.79 (0.41-1.5)	
- Undefined	0.94 (0.65-1.4)	

of 3.8% analyzing HCWs from February 29 to May 18, 2020.

After the first 2 weeks of March, policies to reinforce awareness of infectious risk were soon enforced in the Region resulting in progressive reduction of unprotected contacts reported to the system. However, evidence of lack of or reduced compliance to measures for infection prevention and control while engaging in close contact with colleagues were revealed by surveillance data.

The insidious spread of SARS-CoV-2 among asymptomatic, pre-symptomatic, atypical, or mild infected HCWs have played a role in hospitals and other healthcare facilities during the FVG early epidemic. At the first swab test the 37.7% of HCWs did not report symptoms, a percentage similar to that reported by Gómez-Ochoa et al. (16) in a recent meta-analysis (40%). Though only a periodical screening permits to identify positive HCWs before symptoms and could prevent the spread of the infection.

It should also be pointed out that Trieste has a much higher population density (1,103 Inhabitants / km²) compared to other provinces (i.e., Udine, 106 Inhabitants / km²). This difference might have contributed to increase the contact rate of subjects, and therefore to the larger infectious disease outbreak observed in Trieste where the largest regional COVID-19 hospital is located. Furthermore, in the Friuli Venezia Giulia Region, out of 555 beds dedicated to COVID-19 patients' care, 290 are in Trieste hospitals (52.2%) and 159 (28.6%) in Udine. This also contributed differently to HCWs' exposure to the contagion.

CONCLUSIONS

This observation demonstrates that the HCWs' knowledge of SARS-CoV-2 epidemiology and proper infection control practices is critical to the control of the disease. In accord with other studies (4,16), HCWs accounted for a significant proportion of coronavirus infection and experienced high infection incidence after unprotected contact. The higher prevalence of infection was in the first 2 weeks of exposure, than the better infection control practices and the increase adherence to proper use of personal protective equipment permitted to reduce to zero the number of HCWs infected with SARS-

CoV-2. The periodical screening and the tracing of contacts performed were crucial for the reduction of the infection spread.

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